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The State Of Cloud Computing In Nigeria

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***Abstract**: This work provides lucid explanation of cloud computing, it's components and characteristics. It provides a detailed account of the history of cloud computing and the extent it has been adopted in Africa amidst the economic and infrastructural challenges. A detailed survey of the adoption of this technology in different establishment and coalition in Nigeria was discussed. It was observed that despite the eminent challenges faced in a developing Country like Nigeria, deployment of cloud computing had commenced, and was thriving in finance, business and oil sectors of the country. Suggestions on expanding participants of cloud computing to include small and medium scale enterprises, health sector and others were proffered.*

I. Introduction

In the simplest of terms, Cloud Computing can be described as the use of computing resources, hardware and software, which are delivered as a service over a network, usually the Internet. It generally represents a different way to architect and remotely manage computing resources. The term "Cloud Computing" was coined from the use of cloud-shaped symbols within system diagrams to represent the complexities involved in online computing resources.

Cloud experts disagree on what constitutes the essence of this fundamental shift in technology and thus define it differently. According to the 451 Group, "the cloud is Information Technology (IT) as a Service, delivered by IT resources that are independent of location". Gartner defines it as a style of computing where massively scalable IT-related capabilities are provided as a service across the Internet to multiple external users (Gartner, 2010). Forrester says it is a pool of abstracted, highly scalable, and managed infrastructure capable of hosting end-consumer applications and billed by consumption. Users need not have knowledge of, expertise in, or control over the technology infrastructure "in the cloud" that supports them (Rhoton, 2011). Christopher Barnatt, in his book "A Brief Guide to Cloud Computing" states that cloud computing is where dynamically scalable, device-independent and task-centric computing resources are obtained over the Internet, with any charges being on a per-usage basis (Barnatt, 2010). According to the National Institute for Science and Technology (NIST), Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Mell, 2011). This is the most common definition in use today despite the fact that it is not universally accepted.

This paper discusses the underlying concepts of cloud computing, the major participants, characteristics, service models and deployment modes currently available. It also investigates the state of cloud computing in Africa as a whole and Nigeria in particular.

II. Evolution Of Cloud Computing

Cloud computing evolved from several technologies and business approaches that emerged over the years as shown in Figure 1. These founding concepts date back to the 1950s, when large-scale mainframe computers were introduced in academia and organisations. These mainframes were accessed by thin client computers which had no internal computational capability. Timesharing which involves multiple users having access and sharing the CPU time on a mainframe came into being to help optimize efficiency (Strachey, 1959).
Due to the expense of these powerful computers, many corporations and other entities could avail themselves of computing capability through time sharing and several organizations, such as GE's GEISCO, IBM subsidiary The Service Bureau Corporation (SBC, founded in 1957), Tymshare (founded in 1966), National CSS (founded in 1967 and bought by Dun & Bradstreet in 1979), Dial Data (bought by Tymshare in 1968), and Bolt, Beranek and Newman (BBN) marketed time sharing as a commercial venture. By the 1990s, telecommunication companies branched into affordable virtual private network (VPN) services with improved quality of service. This permitted effective use of their network bandwidth.

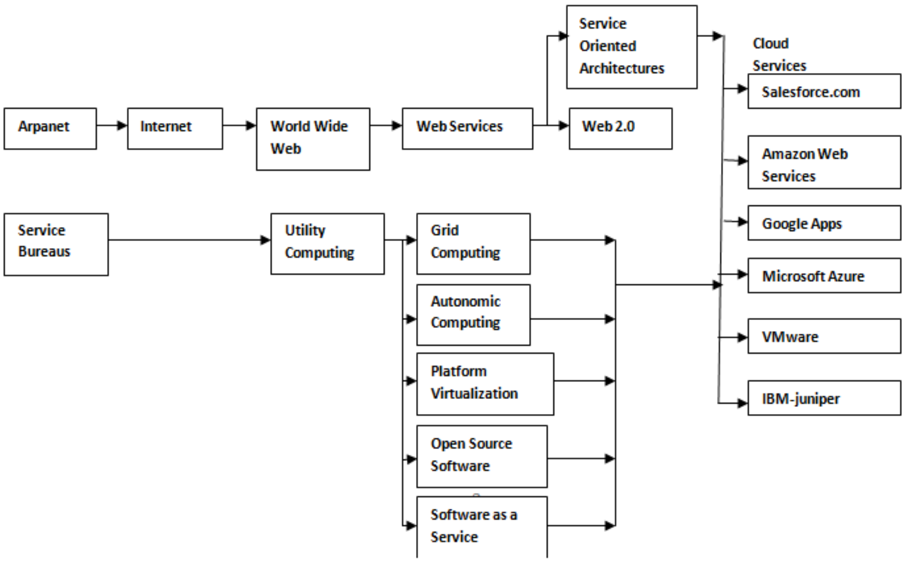

Fig. 1: Origins of Cloud Computing (Krutz, 2010).

The development of the Internet from being document centric via semantic data towards more services was described as "Dynamic Web" (Tolk, 2006). This contribution focused in particular on the need for better meta-data able to describe not only implementation details but also conceptual details of model-based applications. The ubiquitous availability of high-capacity networks, low-cost computers and storage devices as well as the widespread adoption of hardware virtualization, service-oriented architecture, autonomic, and utility computing have led to a tremendous growth in cloud computing (The Economist, 2009; Gartner, 2010; Gruman, 2008). Amazon played a key role in the development of cloud computing by modernizing their data centres, deploying new cloud architecture which resulted in significant internal efficiency improvements and initiating a new product development effort to provide cloud computing to external customers. In 2006, Amazon launched Amazon Web Service (AWS) on a utility computing basis (Brooks, 2010; Hof, 2006).

In early 2008, Eucalyptus became the first open-source, AWS API-compatible platform for deploying private clouds. In early 2008, OpenNebula, enhanced in the RESERVOIR European Commission-funded project, became the first open-source software for deploying private and hybrid clouds, and for the federation of clouds (Rochwerger, 2009). In the same year, efforts were focused on providing quality of service guarantees (as required by real-time interactive applications) to cloud-based infrastructures, in the framework of the IRMOS European Commission-funded project, resulting to a real-time cloud environment (Kzriazis, 2010). On March 1, 2011, IBM announced the Smarter Computing framework to support Smarter Planet (Hall, 2011). Among the various components of the Smarter Computing foundation, cloud computing was a critical piece. ***Cloud computing evolution resulted in a myriad of possible participants.***

III. Cloud Computing Participants

An ecosystem of participants defines the cloud computing market and it consists of consumers, service providers, service designers and *system integrators as cloud service providers.*

Consumers: There are different types of consumers. A cloud services consumer might be an individual, or a small business team. Departments in large companies can be cloud services consumers. The IT Department can use cloud services to either supplement existing data centre services, or to provide specific cloud-based applications such as customer relationship management (CRM) to the Sales Department. Likewise, even a company that provides cloud services to consumers may use third-party cloud services to supplement their capacity.

Service providers: These are companies that offer packaged services to consumers. Many different types of providers range from those who offer services to individuals and those who serve a broad set of constituents. Many service providers focus on certain markets or certain types of workloads so they can optimize their offerings inexpensively. Thousands of cloud services providers provide public cloud services. Other service providers offer private clouds to support specialized services. A service provider can also be the consumer of a service they acquire to support their customers. Some traditional businesses have taken on the role of becoming a service provider to their customers and partners. These companies are discovering that like professional service providers, they can create a private cloud and offer their own set of services to their customers, which are viewed as a new source of revenue.

Service designers: Companies that create sophisticated services, tools, and applications to support a variety of cloud models have a huge opportunity. These designers typically build everything from a full "Software as a Service" (SaaS) platform to tools needed for developers or deployers of cloud services. For example, there is an emerging market for companies that design security and governance offerings to support a variety of cloud models.

System Integrators as Cloud Service Providers: This category is a combination of the first three. That is, system integrators can be consumers of cloud services, they can become service providers themselves or they can design cloud services. System integrators are helping customers integrate their data centre with public cloud services and private cloud environments. They are helping define best practices and implementation road maps. These integrators can provide private clouds that they can host and manage for customers (Hurwitz, 2012).

Cloud users access resources via networked client devices, such as mobile phones, personal computers, laptops and tablets. These are also referred to as cloud clients and depend on the cloud for some or all of their functionality. An example of this thin client is the browser-based Chromebook. Thus, the device runs the applications on the cloud and does not need to have the application installed. With Ajax and HTML5 these Web user interfaces can achieve a similar or improved environment as native applications. Some cloud applications, however, support specific client software dedicated to these applications as is the case with most email service applications. ***It is pertinent to understand what makes up a cloud computing.***

IV. Characteristics Of Cloud Computing

There are several characteristics which when combined set cloud computing apart from other technologies. Some of these characteristics are:

On-demand self-service: A consumer can independently request for cloud computing capabilities, such as server time and network storage, using cloud service catalogues as needed automatically without requiring human interaction with each service's provider (Mell, 2011).

Broad network access: Cloud resources are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g. mobile phones, laptops, and PDAs).

Resource pooling: The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or data centre).

Rapid elasticity: Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out, and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

Measured service: Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts) used. Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service (Mell, 2011).

Off-premises: The service is hosted and delivered from a location that belongs to the service provider. This usually has two implications: the service is delivered over the public Internet and the processing occurs outside the user's firewall. In other words, the server must cross both physical and security boundaries.

Flexible billing: The elasticity of cloud computing as earlier explained can equate to direct cost savings. Fine-grained metering of resource usage, combined with on-demand service provisioning, facilitate a number of options for charging customers. Fees can be levied on a subscription basis or can be tied to actual consumption, or reservation, of resources. Monetization can take the form of placed advertising or can rely on simple credit card charges in addition to elaborate contracts and central billing (Rhoton, 2011). As cloud computing is dynamically scalable and task-centric, for most users it has no fixed cost. Software applications purchased from the cloud incur only variable costs. When provision is not free, charges are typically based on the number of people using an application each month, or the number of records or projects being worked on. Thus, the fact that cloud computing has only variable costs is extremely important for small companies as they can now access all kinds of sophisticated business software applications previously only available to much larger corporations. Examples of such software applications include the latest versions of human resource, project management and customer relationship management (CRM) applications (Barnatt, 2010).

Service delivery: Cloud functionality is often available as a service of some form. While there is great variance in the nature of these services, typically the services offer programmatic interfaces in addition to the user interfaces.

Simplified management: Administration is simplified through automatic provisioning to meet scalability requirements, user self-service to expedite business processes and programmatically accessible resources that facilitate integration into enterprise management frameworks.
Affordable resources: The cost of resources is dramatically reduced for two reasons. There is no requirement for capital expenditures on fixed purchases. Also, the economy of scale of the service providers allow them to optimize their cost structure with commodity hardware and fine-tuned operational procedures that are not easily matched by most companies.
Service-level management: Cloud services typically offer a service-level definition that sets the expectation with the customer as to how robust that service will be. Some services may come with only minimal or non-existent commitments. They can still be considered cloud services but will not be "trusted" for mission-critical applications to the extent that others governed by more precise commitments might (Rhoton, 2011).
Multi-tenancy: The cloud is used by many organizations (tenants) and includes mechanisms to protect and isolate each tenant from all others. Pooling resources across customers is an important factor in achieving scalability and cost savings (Rhoton, 2011). Multi-tenancy enables sharing of resources and costs across a large pool of users thus allowing for centralization of infrastructure in locations with lower costs, peak-load capacity increases as well as utilisation and efficiency improvements for systems that are often only 10–20% utilised (Hof, 2006).
Device-independent: Cloud computing resources can be accessed by any kind of computer. Provided that such a computer has an Internet connection and a web browser, it really does not matter if the computer is a traditional desktop or laptop PC, or even a netbook, tablet, smart phone, e-book reader, surface computer, ambient device or any other new computing appliance. This is a radically new development as even though it has become easy over the past decade to exchange data between different computers, there remains a requirement for the right software to be installed. For instance, if a Microsoft PowerPoint presentation is created and sent as an e-mail attachment, the recipient needs to have the Microsoft PowerPoint software application installed on his computer system to be able to open and edit the file in a completely compatible manner. However, if the cloud service Google Docs is used to create the presentation, the e-mail attachment could be opened and edited on any kind of computer system with an Internet connection and web browser. (Barnatt, 2010)
Task-centric: Cloud computing is task-centric because the usage model is based entirely around what users want to achieve, rather than any particular software, hardware or network infrastructure. Users do not need to purchase or install anything before using a cloud computing resource. Nor do they have to maintain or pay for anything during periods in which no resources are being used. Simply put, cloud computing allows a consumer to simply get on with the task at hand without bothering about the location and installation of the tools being used.
Ease of maintenance: Maintenance of cloud computing applications is easier, because they do not need to be installed on each user's computer and can be accessed from different places.
Cloud computing may be characterized by one or all of the above mentioned attributes. It provides a certain service to its participants and these have been categorized into service models. These service models can be implemented in various ways.

V. Cloud Computing Service Models

In cloud computing, there is several service models which refers to the type of service provided to the consumer by the cloud service provider. One characteristic aspect of cloud computing is a strong focus toward service orientation. Rather than offering only packaged solutions that are installed directly on desktops and servers, or investing in single-purpose appliances, the functionality that users require are broken down into basic modules that can be assembled as required. Thus, a classification structure was formulated to illustrate the relationships between services. The most common classification uses the SPI (**S**oftware as a Service, **P**latform as a Service, **I**nfrastructure as a Service) model (Mell, 2011) displayed in Figure 2.

Fig. 2: Some cloud resources for the different service models

These three service models differ in the extent of sharing they imply for their customers. Infrastructure services share the physical hardware. Platform services allow tenants to share the same operating system and application frameworks. Software services share the entire software stack. As shown in Figure 3, these three approaches represent different tradeoffs in a balance between optimization, which leverages multi-tenancy and massive scalability, on the one hand, and flexibility to accommodate individual constraints and custom functionality, on the other hand.

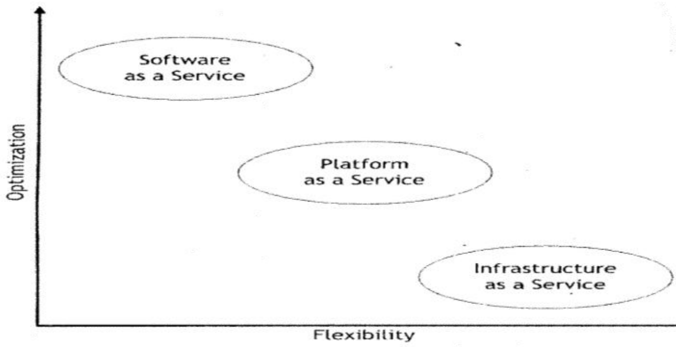

Fig. 3: Software, Platform and Infrastructure Services (Rhoton, 2011).

Software services are typically highly standardized and tuned for efficiency. However, they can only facilitate minor extensions. At the other extreme, infrastructure services can host almost any application but are not able to leverage the benefits of economy of scope as easily. Platform services represent a middle ground as they provide flexible frameworks with only a few constraints and are able to accommodate some degree of optimization (Rhoton, 2011).

Software as a Service (SaaS): The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based email). The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings (Mell, 2011). Examples of SaaS include: Google Apps, TradeCard, Microsoft Office 365, Onlive and GT Nexus.

Platform as a Service (PaaS): The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations (Mell, 2011). Examples of PaaS include: AWS Elastic Beanstalk, EngineYard, Cloud Foundry, Heroku, Force.com, OrangeScape, Mendix, Google App Engine, and Windows Azure Cloud Services.

Infrastructure as a Service (IaaS): The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components such as host firewalls (Mell, 2011). Examples of IaaS providers include Open Stack Distribution Stack Ops, Amazon Cloud Formation, Amazon EC2, Windows Azure Virtual Machines, DynDNS, Google Compute Engine and HP Cloud. In 2012, Network as a Service (NaaS) and Communication as a Service (CaaS) were officially included by ITU (International Telecommunication Union) as part of the basic cloud computing models, recognized service categories of a telecommunication-centric cloud ecosystem (ITU-T, 2012).

Cloud Network as a Service (NaaS)**:** A category of cloud services where the capability provided to the cloud service user is to use network/transport connectivity services and/or inter-cloud network connectivity services (ITU-T, 2012). NaaS involves the optimization of resource allocations by considering network and computing resources as a unified whole (Gabrielsson, 2010).

Traditional NaaS services include flexible and extended Virtual Private Network (VPN), and bandwidth on demand. NaaS concept materialization also includes the provision of a virtual network service by the owners of the network infrastructure to a third party Virtual Network Provider (VNP) or Virtual Network Operator (VNO) (Carapinha, 2010).

Cloud Communication as a Service (CaaS)**:** This is an outsourced enterprise communications solution that can be leased from a single vendor. Such communication can include voice over IP (VoIP or Internet Telephony), Instant Messaging (IM), collaboration and videoconference applications using fixed and mobile devices. CaaS has evolved along the same lines as Software as a Service (SaaS). The CaaS vendor is responsible for all hardware and software management and offers guaranteed Quality of Service (QoS). CaaS allows businesses to selectively deploy communications services and models on a pay-as-you-go, as-needed basis. This approach eliminates the large capital investment and ongoing overhead for a system whose capacity may often exceed or fall short of current demand. There is no risk of the system Becoming obsolete and requiring periodic major upgrades or replacement (Rouse, 2008).

VI. Cloud Computing Deployment Models

There are four main deployment models for cloud computing, namely Private Cloud, Community Cloud, Public Cloud and Hybrid Cloud.
A depiction of these four cloud deployment models is shown in Figure 4.

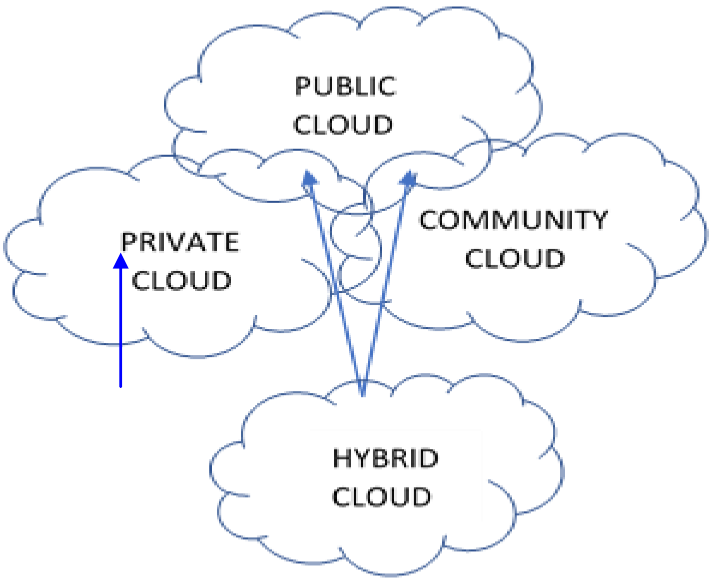

Fig. 4: Cloud Computing Deployment Models

Table 1: Comparison of the different Cloud Deployment Models

CRITERIA	PUBLIC	PRIVATE	COMMUNITY	HYBRID
Initial cost	Typically zero	Typically high	Shared	Typically moderate
Running cost	Predictable	Unpredictable	Unpredictable	unpredictable
Customization	Impossible	Possible	Possible	Possible
Privacy	No (Host has access to the data)	Yes	Yes	No
Single sign-on	Impossible	Possible	Impossible	Impossible
Scaling up	Easy while within defined limits	Laborious but no limits	Possible	Possible

Private Cloud*:* The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.

Community Cloud: The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on premise or off premise.

Public Cloud*:* The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

Hybrid Cloud: The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds) (Mell, 2011).
The following Table 1 gives a comparison based on cost, privacy, scalability, sign-on capabilities and so on among the four cloud deployment models currently available.

The successful deployment of cloud computing has been projected to follow an adoption curve.

VII. Cloud Adoption Curve

Cloud computing is now seriously and rapidly entering the main stream. In 2009 scepticism was still rife but by 2010 there was a strong and growing awareness of cloud computing's competitive, environmental and innovatory paybacks. As network computing giant Sun Microsystems argued in one of its recent white papers, 'cloud computing is the next generation' and is now well and truly 'taking the information technology world by storm'. 2010 is treated by most analysts as the first really big year of cloud computing and it is forecast that the transition to mainstream cloud computing will take about a decade. Given such analysis, Figure 5 illustrates a likely cloud computing adoption curve. The vertical axis in Figure 5 plots the number of firms transitioning in whole or part to cloud computing in a particular year. As the figure shows, between 2005 and 2010 the steadily rising number of firms embracing cloud computing were all pioneers. Cloud computing's second phase of mainstream early adoption runs from 2010 to 2015. The number of companies involved is expected to peak around 2015, with the second part of the decade comprising a mainstream phase of late adoption. By 2020 it is then likely that a 'laggard' period in which most of the remaining companies will start using cloud computing. *While the supply, if not the application, of computing resources will in future cease to give a competitive advantage, there is at present a medium-term competitive payback to be gained from being an early adopter.* This is because companies who are early adopters of cloud computing will obtain cost savings and innovation gains that the laggards will not yet be reaping. Speculatively, by 2020 the playing field will have evened out and few companies will be overpaying for their computing resources. However, the opportunity to run computing more effectively than others for even a few years is something that no organization should ignore (Barnatt, 2010).

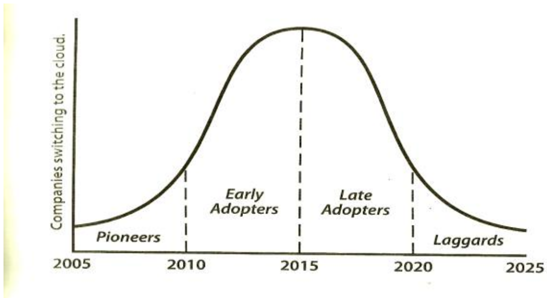

Fig. 5. Cloud Adoption Curve (Barnatt, 2010)

VIII. State Of Cloud Computing In Africa

Africa, despite being home to billions of people who don't even own a computer, much less an internet connection, may ironically be one of the places that will benefit dramatically from cloud computing. The multitude of challenges facing the continent actually make Africa a fertile ground for cloud computing, because it paves the way for mobile applications on the cloud. According to data from the World Bank, while only an estimated 140 million out of 1 billion people on the continent use the Internet; there are 650 million mobile phone users (World Bank, 2012). Several issues need to be addressed before cloud computing becomes viable in Africa. First is the availability of broadband internet, which has been a problem for businesses who wish to set up in Africa. Fortunately, Africa is receptive to progress, and bandwidth in their country is showing dramatic improvements over the past few years.

Besides broadband issues, potential cloud service providers in Africa need to face another important problem: the power grid. While South Africa is already enjoying first world utilities in many aspects, electrical service is not one of them. The incumbent power provider is not very reliable, resulting in frequent outages. Besides being unreliable, there's also a lack of electrical capacity – there's simply not enough power being generated to sustain large companies with server farms. This very serious infrastructure problem scares away companies from building data centres in Africa.

Ironically, it is Africa's shortcomings in wired infrastructure that made the region a good place for cloud adoption. One of the key results of the lack of decent and affordable wired services is that people have instead adopted mobile application services. In some cases, mobile applications of certain types have usage statistics that dwarf even the US's. An example is Safaricom's M-PESA mobile payment system, which provides a way for customers to transfer money to each other through mobile phones. Compared to wired internet, the deployment of mobile bandwidth in Africa is significantly easier, both from a financial and cultural perspective. A recent World Bank study even revealed that 97 percent of Africa's population can be covered by mobile without the need for any government subsidy.

Even Africa's problem with electricity is solved by mobile devices, as mobile devices tend to be rechargeable and don't need to be connected to an outlet all the time. In fact, even areas where there are no electric grid have mobile users, since recharging can be done via generators and solar cells. Africa will be the continent that will show the industry that the true path to the cloud is not only independent of the PC, but of the Web as well. The key difference with mobile users in Africa and those in more developed countries is that while the latter use their mobile devices to access Web content, the former tend to stay off the Web and stick to content within apps, without even realizing that they're web based as well. This could bode well for a lot of cloud apps that are being marketed as "apps" for mobile devices instead of web-based interfaces.

The main takeaway from Africa's cloud computing industry is that one of the key drivers of success is a company's ability to pay attention to the needs of users on a local level. You need to offer services that are relevant to the target audience – in culture, needs, and financial capabilities. This is a lesson that the West needs to learn right now, instead of assuming that cloud computing applications are a universal service that doesn't need to be tailored specifically on a user-per-user basis (Cruz, 2012).

IX. State Of Cloud Computing In Nigeria

Infrastructure Challenge, Anxiety over Safety and Security of data and Government Policies are factors that stall cloud computing growth. Despite the lots of effort there has been a slowly dwindling reluctance to embrace this new technological trend in most of Nigeria's business circle. This can also be linked to their reluctance and resistance towards having their technology assets hosted and managed by third parties (Ogunjobi, 2015).

Cloud computing technology provides the best path towards achieving efficient and sustainable online data service to the target market. Due to the cost of maintenance there is need to outsource these functions to a third party to reduce capital and operational expenses. Major cloud providers such as Microsoft, IBM, Google and Cisco have put in place structures that drive the spread of cloud computing in Nigeria by either providing the cloud services directly to organisations or in partnership with local IT firms for better integration and penetration.

Various cloud services providers and services include:

Microsoft: which offers Microsoft Azure, Microsoft Bing and Windows Live? In 2012, Wema Bank Nigeria Plc, partnered withh Microsoft and makes use of MS Exchange 2010, MS SharePoint Server 2010 and MS Lync Server 2010. Similarly, Nigerian Airspace Management Agency (NAMA) deployed Windows Server 2012 which enables several functions and saves cost.

Cisco, NetApp and Microsoft collaboration: to provide robust cloud services to users and subscribers. NetApp technology is used by the Central Bank of Nigeria (C.B.N.) as well as the top eight (8) banks in Nigeria (Nnadozie, 2013). The introduction of Nigerian Uniform Bank Account Number (NUBAN) is a milestone in the Nigerian banking sector brought about by cloud computing. This is because the cost of infrastructure and software provisions are no longer borne by the individual banks alone, but are shared among banks to reduce the cost of doing business and thus boost their profitability.

IBM: Airtel Nigeria recently outsourced its data centre infrastructure in Lagos to IBM; thereby giving IBM managerial rights and reducing operational cost.

IBM and Sunnet Technology solution provider: this partnership was geared towards enhancing Nigerian businesses by offering organizations a dynamic infrastructure and cloud computing solution at reduced cost and risk.

Google's key partners with Descasio Ltd: they have numerous clients like Coscharis Group, Transcorp, AMCOM, etc.

Google Apps Engine cloud platform provides: an avenue for searches to be performed with much data storage space available; hosting documents of different format; easy downloads etc. For example, Gmail provides each user with up to 10GB inbox storage space in the cloud (Nnadozie, 2013).

Wyse Technology: a cloud provider offers its services to Electronic Test Company (eTC) in the conduct of examinations in Nigeria. With this development, testing will be fast and reliable devoid of inherent fraud that characterizes the traditional paper-based examinations (Wyse, 2011).

MainOne Technologies and MDX-i partnership: A partnership built on Microsoft Azure's enterprise grade infrastructure which provides flexible, highly available and fully secure private computing environments to companies on a Pay-as-you-Go basis (Udofia, 2015).

Cloud computing is also receiving a strong push from the public sector, with Rivers State Government introducing the RIV Cloud in April 2012 with support from MTN and GLOBACOM. This platform provides storage and application hosting to both public and private sectors, and will migrate tax filings online. The Nigerian National Petroleum Corporation (NNPC) also built a private cloud in July 2012. The Tier+3 data centre is expected to save the NNPC some $5million dollars yearly by centralising operations like its procurement platform, its intranet and Microsoft exchange mail service.

Industry analysts opined that Nigeria has a cloud computing market potential of over $1 billion if broadband infrastructure bottlenecks are quickly addressed to deepen internet penetration (Uzor, 2012). IT organizations and multinational data outfits, at the moment, are faced with the problem of dealing with big data in relation to how these data can add value to individuals.

X. Conclusion

The emergence of cloud computing is revolutionising the world and Nigeria must fully tap into these potentials that abound therein. The huge developmental impact on telecommunication will create a positive ripple effect in other sectors of Nigeria's economy. Small scale businesses in a particular region could share cloud resources by running a community cloud while bigger organizations can adopt the more expensive but more secure private cloud. To guarantee this, the necessary infrastructure such as steady electric power supply, backbone networks, high internet speed and penetration must be on ground. Government must take active part in formulating and implementing policies that will enable cloud solution providers to partner effectively and seamlessly with IT firms in Nigeria. A series of awareness campaigns must also be executed to engage businesses with adequate information on the benefits of cloud computing. Hardware manufacturing firms need to be set up as a cost reduction measure towards building data centres across Nigeria. Issues pertaining to data security and privacy on the cloud will also need to be squarely addressed to engender acceptance of cloud computing technology by businesses and organizations nationwide.

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